

HYMENOPTERA ASSOCIATED WITH PIG CARRION

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ABSTRACT—Decomposing pigs (*Sus scrofa* L.) were exposed under various ecological conditions in South Carolina over a period of several years, and a faunistic survey and succession was compiled for the microcommunity of carrion animals that was attracted to them. This paper tabulates the 82 spp. of Hymenoptera collected, and records observations of their habits and possible relationships in the carrion community. Two new species, *Aphaereta soronastes*, n. sp. (Braconidae) and *Atractodes neerix*, n. sp. (Ichneumonidae) are described.

Carrion, despite the obvious disadvantages, recently has become a popular subject for research. The dead bodies of animals have incited numerous writings; the literature has included studies of problems of agricultural importance, medico-legal importance, and the biology and taxonomy of certain beetles and flies, but there have been few attempts to record and observe the complete fauna of carrion, including the so-called incidental or secondary species.

During the summers of 1962 and 1963, the entire year of 1966, and the spring of 1967, a comparative study of pig carcasses, both exposed to and isolated from arthropods, was undertaken to determine the actual processes and rates of decomposition (Payne, 1965; 1967). Animal succession and decomposition of carrion were studied under different environmental conditions. Baby pigs, *Sus scrofa* Linnaeus, were suspended from trees at various heights, placed in water, buried in the ground, and maintained free from, partially free from, and completely exposed to insects. For brevity, pigs in the last category are indicated here as "open" or "grounded."

A faunal survey was conducted in conjunction with this study (Payne, Mead, and King, 1968; Payne and King, 1969). Special attention was focused on the food habits, relative abundance, succession, and microseral distribution of individual members of the carrion microcommunity. The present paper deals with the hymenopterous species which were associated with the various stages.

METHODS AND MATERIALS

Carcasses were frequently examined for insects; collections were made at various times of the day and night. Excavations beneath the

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carrion were searched thoroughly by using a gardener's tool. Larvae suspected of being parasitized were collected for rearing of the parasites in the laboratory. Some insect-open or grounded carcasses were painted or coated with mevinphos, a phosphate insecticide. This permitted nearly complete collections of insects from all stages of decay, since most arthropods which visited the mevinphos-coated carrion were immobilized or quickly killed.

At the termination of each experiment (60 or more days of observation), carcass remains were collected from their respective cages and thoroughly examined for fauna. The remains of all buried and most other pigs were placed in Berlese funnels for extraction of arthropods.

RESULTS AND DISCUSSION

Eighty-two species of Hymenoptera were collected from pig carrion. Table 1 gives the systematic list of all 82 species and the exposure type from which collected. A brief synopsis of these species and their food habits follows.

Braconidae—*Alysia ridibunda* Say was the most common braconid at carrion and was attracted to carrion during the active and advanced decay stages when dipterous larvae were most abundant. These wasps were often found crawling in the cracks and crevices of the carcass and even observed probing in the decaying flesh with their ovipositor. This parasite has been reared from several *Calliphora*, *Lucilia* and *Sarcophaga* species inhabiting carcasses (Roberts, 1935).

Aphaereta soronastes Mason,² a parasitic braconid, was reared from *Fannia* pupae from grounded and water carcasses. It was also observed probing for *Phaenicia* maggots concealed under the skin of pig carcasses. Members of the subfamily Microgasterinae which include *Apanteles* and *Microplitis* all seem to be internal parasites of lepidopterous larvae (Muesebeck and Walkley, 1951); *Apanteles carpatus* (Say) was reared from larvae of *Ascedes fuscipuntella* (Haworth) and *A. pallescentella* (Stainton), tineids which occupied these remains (Payne and King, 1969).

Ichneumonidae—Members of the genus *Atractodes* were the most common ichneumonid attracted to carrion, even one new species, *Atractodes necrix* Mason,² was collected. Females of *Atractodes* attacked exposed larvae of *Phaenicia*; however, no parasites were recovered from these maggots. They are believed to be parasitic on carrion-inhabiting muscoid Diptera and have been reared from *Hydrotaea dentipes* Fabricius (Myers, 1929).

Xenolytus sp. was reared from tree pig remains; they were suspected of parasitizing tineid larvae occupying these remains. The genera

² Description of this new species follows the discussion of food habits.

Table 1. Systematic list of species and the dead pig exposure type from which collected during 1962, 1963, 1966, and 1967.

Species	Exposure*
Order HYMENOPTERA	
Family Braconidae	
<i>Apanteles carpatus</i> (Say)	T
<i>Apanteles</i> spp.**	IO, T
<i>Microplitis</i> sp.	T
<i>Aphaereta pallipes</i> (Say)	IO, W
<i>Aphaereta soronastes</i> Mason	IO, W
<i>Alysia ridibunda</i> Say	IO, T, W
<i>Rogas</i> spp.	IO
<i>Bucculatriplex bucculatricis</i> (Ashmead)	IO
<i>Pauesia</i> sp.**	IO
Family Ichneumonidae	
<i>Alegina</i> sp.	T
<i>Gelis</i> sp.**	IO
<i>Xenolytus</i> sp.	T
<i>Endasys subclavatus</i> (Say)**	IO, T
<i>Atractodes americanus</i> Ashmead	IO
<i>Atractodes necrix</i> Mason	IO
<i>Phacogenes</i> sp.	IO
<i>Cratichneumon paratus</i> (Say)	IO
<i>Temelucha</i> sp.	IO
<i>Habrocryptoides rufifrons</i> (Walsh)	IO
<i>Ischnus ciuitipes</i> (Walsh)	IO
Family Eulophidae	
<i>Dicladocerus</i> sp.	B
<i>Tetrastichus</i> sp.	T
Family Pteromalidae	
<i>Spalangia nigra</i> Latreille	T
<i>Spalangia drosophilae</i> Ashmead	T
<i>Pachycrepoides dubius</i> Ashmead	T
<i>Pachycrepoides vindaemniae</i> (Rondani)	T
<i>Muscidifurax raptor</i> Girault and Sanders	T
Family Figitidae	
<i>Neralsia</i> sp.	W
<i>Figites</i> sp.	IO, T, W
Family Cynipidae	
<i>Kleidotoma</i> sp.	B
<i>Ganaspis</i> sp.	T, B
<i>Pseudeucoila</i> sp.	IO, T, W

* IO—Insect-open, or grounded, T—Tree, W—Water, B—Buried.

** For record only. No evidence of attraction to carrion community.

Table 1. (Continued)

Species	Exposure*
<i>Ceroptres</i> sp.**	W
<i>Neuroterus</i> sp.**	IO, T
<i>Andricus flavohirtus</i> Beutenmueller**	IO, T, W
<i>Callirhytis futilis</i> (Osten Sacken)**	IO, T, W
Family Evaniidae	
<i>Hyptia harpyoides</i> Bradley	IO
Family Pelecinidae	
<i>Pelecinus polyturator</i> (Drury)	IO
Family Proctotrupidae	
<i>Cryptoserphus abruptus</i> (Say)	IO
<i>Codrus</i> sp.	IO
Family Diapriidae	
<i>Aneurhynchus</i> sp.	IO
<i>Psilus</i> sp.	IO
<i>Trichopria</i> sp. (poss. <i>haematobiae</i> Ashmead)	T, B
Family Mutillidae	
<i>Pseudomethoca simillima</i> (Smith)	IO
Family Formicidae	
<i>Amblyopone pallipes</i> (Haldeman)	IO
<i>Euponera</i> sp.	B
<i>Proceratium silaceum</i> Roger	IO
<i>Ponera coarctata pennsylvanica</i> Buckley	IO, W, B
<i>Stenamma meridionale</i> Smith	IO
<i>Stenamma diecki</i> Emery	IO
<i>Aphaenogaster fulva</i> Roger	B
<i>Aphaenogaster lamellidens</i> Mayr	IO
<i>Aphaenogaster rudis</i> Emery	IO
<i>Aphaenogaster texana</i> (Emery)	IO, B
<i>Phcidole bicarinata vinelandica</i> (Forel)	IO
<i>Crematogaster cerasi</i> (Fitch)	IO
<i>Monomorium minimum</i> (Buckley)	IO
<i>Myrmecina americana</i> Emery	IO, B
<i>Leptothorax curvispinosus</i> Mayr	IO, W
<i>Leptothorax schaumi</i> Roger	W
<i>Smithistruma</i> sp.	IO
<i>Dorymyrmex</i> sp.	IO
<i>Camponotus americanus</i> Mayr	IO, W
<i>Camponotus ferrugineus</i> (Fabricius)	IO
<i>Camponotus nearcticus</i> Emery	IO
<i>Camponotus pennsylvanicus</i> (DeGeer)	IO, T, W
<i>Camponotus subbarbatus</i> Emery	B
<i>Paratrechina parvula</i> (Mayr)	IO, W

Table 1. (Continued).

Species	Exposure*
<i>Prenolepis imparis</i> (Say)	IO, T, B
<i>Formica</i> sp.	IO, B
Family Vespidae	
<i>Vespula maculifrons</i> (Buysson)	IO, T, W
<i>Vespula maculata</i> (Linnaeus)	IO, T, W
Family Pompilidae	
<i>Auplopus nigrellus</i> (Banks)	IO
<i>Aporus niger</i> (Cresson)	IO, W
<i>Psorthaspis mariae</i> (Cresson)	IO
Family Sphecidae	
<i>Trypoxylon carinatus</i> Say	IO
Family Halictidae	
<i>Halictus</i> sp.	IO, T, W
<i>Lasioglossum</i> sp.	IO, W
Family Apidae	
<i>Xylocopa virginica</i> (Linnaeus)	IO, T
<i>Bombus grisecollis</i> (DeGeer)	T
<i>Bombus impatiens</i> Cresson	IO, T, W
<i>Apis mellifera</i> Linnaeus	IO, T, W

Phaeogenes, *Temeluca*, and *Ischnus* were represented at carrion. Their normal hosts are Lepidoptera larvae; however, no observations on these parasites were made.

Eulophidae—*Tetrastichus* was collected from tree pig remains. Members of the subfamily Tetrastichinae develop as internal parasites of the eggs, larvae, or pupae of other insects (Clausen, 1940). Host records for this genus even include tineid larvae, the normal inhabitants of tree pig remains. Two specimens of *Di cladocerus* were recovered from buried pigs. No information is available on possible hosts but phorid or sphaerocerid larvae appear likely since they occupied this buried pig (Payne, King, and Beinhart, 1968).

Pteromalidae—Five species were collected from tree pigs. *Spalangia drosophilae* Ashmead was reared from puparia of *Drosophila* sp. occupying tree carrion; however, it was not recovered from *Drosophila* on carrion in other exposures. Hosts of *Spalangia nigra* Latreille were not determined in this study. *Pachycrepoideus dubius* Ashmead is a pupal parasite of various Diptera (Nostvik, 1954). *Phaenicia caerulei-viridis* (Macquart) and *Piophilila* spp. were the dominant hosts on tree carrion. It is somewhat surprising that *Pachycrepoideus* were not re-

covered from carrion in the other exposures. *Muscidifurax raptor* Girault and Sanders, a common parasite of blow flies, was only captured once during this study.

Cynipidae—Seven species of cynipids were collected from pig carrion; four of these were gall producers on oaks and their attraction to carrion cannot be explained. *Pseudeucoila* sp. was reared from puparia of *Conioscinella hinkleyi* (Malloch), a chloropid inhabiting tree pig remains. *Kleidotoma* sp. and *Ganaspis* sp. were taken from buried carrion; however their hosts are unknown. James (1928) has reared *Kleidotoma* from *Lucilia*, *Musca* and *Hydrotaea*, all common carrion maggots.

Figitidae—Two genera, *Figites* and *Neralsia* were reared from caliphorid and sarcophagid puparia. These small parasites were attracted to carrion during the early stages of decomposition when *Phaenicia* and *Sarcophaga* larvae were the prevalent species. Exposed larvae were normally parasitized; however, *Figites* would even enter the carcass in search of prey. *Neralsia* were only observed parasitizing exposed larvae of water carrion.

Evaniidae—The evaniids are all thought to be parasitic in the egg capsules of cockroaches. Townes (1951) reported that our common native species of *Hyptia* were presumed to be parasites of *Parcoblatta*. *Hyptia harpyoides* Bradley was observed flying about dried pig carcasses under which *Parcoblatta* spp. were usually found.

Pelecinidae—Only two specimens of *Pelecinus polyturator* (Drury) were recorded during the entire study. They were crawling about the moist carrion as if in search of food or host. It is assumed that *Pelecinus* parasitizes the larvae of soil-inhabiting Scarabaeidae (Muesebeck and Walkley, 1951).

Proctotrupidae—*Cryptoserphus abruptus* (Say) and *Codrus* sp. were collected from insect-open carrion in active and advanced decay. No observation on habits was noted. Clausen (1940) reported that a number of species of this family are parasites of the larvae of various Coleoptera and Diptera.

Diapriidae—The genera *Aneurhynchus* and *Psilus* were represented at insect-open carrion and *Trichopria* at tree and buried carrion. These small black insects are believed to be internal parasites of the immature stages of Diptera (Clausen, 1940). *Trichopria* and *Aneurhynchus* have been reared from carrion Diptera by Graham-Smith (1919) and Roberts (1935). No observations on parasitization were made in this study. These small wasps were seldom recovered probably due to their small size.

Mutillidae—One species, *Pseudomethoca simillima* (Smith), was observed as a rather frequent visitor to the carrion. Mutillids are gen-

erally accepted as being predaceous or parasitic on other Hymenoptera, Coleoptera, and Diptera.

Formicidae—Ants fed actively during all stages of carrion decomposition. They were observed carrying off maggots and eggs of other insects in large quantities, and feeding on the carrion soups and scraps. Ants were the principal and only observed omnivores for buried pigs. Fuller (1934) believed that ants could not be considered regular carrion inhabitants of any influence since they were found on only a few carcasses near nests. The authors, however, hold the opposite opinion, since ants were found on all carcasses. *Camponotus americanus* Mayr and *Prenolepis imparis* (Say) were the numerically dominant ant species at the carrion; they were most active in early morning, late afternoon, and into the night. Ants of several different species remained even after the maggots had left, feeding on bits of carrion scraps and dead insects.

Vespidae—*Vespula maculifrons* (Buysson) and *Vespula maculata* (Linnaeus) were collected from inspect-open, tree, and water carcasses. They were observed feeding on dipterous eggs, larvae, and even adults. They also fed on the carcass especially when it was fresh or nearly so; however, their role as predator was more important. Bromley (1931) made an extensive study of hornet habits. He reported that yellow jackets fed on all sorts of organic matter and were also predaceous. Graham-Smith (1916) reported that blow flies, green-bottle flies, and other flies attracted to carrion were often captured by the common species of wasps. Davis (1919) observed *Vespula maculata* feeding on a dead house sparrow and a water snake. Vespids and ants were opportunists and fed upon what was available in quantity and thus their position as scavenger, predator, or omnivore changed with stage of decay.

Pompilidae—Three species, *Auplopus nigrellus* (Banks), *Aporus niger* (Cresson), and *Psorthaspis mariae* (Cresson) visited the carcasses. Members of this family provision their nests with spiders. The pompilids observed here could have been searching for spiders. Carcasses in the dried condition harbored over 70 different spider species (Payne, 1967).

Sphecidae—One species, *Trypoxylon carinatus* (Say) was collected. Members of this genus also provisioned their nests with spiders (Krombein, 1951). The carrion may have established a concentration of spiders due to the presence of the many insects.

Halictidae—Halictids normally feed on pollen and nectar of flowers; however, *Lasioglossum* sp. was collected from insect-open and water pig carrion, apparently feeding on the fluids present. Six species of *Augochlora* and *Halictus* were collected from dog carcasses in Tennessee (Reed, 1958).

Apidae—*Apis mellifera* Linnaeus, *Bombus grisecollis* (DeGeer), *Bombus impatiens* Cresson, and *Xylocopa virginica* (Linnaeus), were attracted to the carrion only while fluids were present. They were observed sucking up the foul-smelling juices. Some of the odors of putrefaction may have served to orient the bees to the carrion media.

DESCRIPTIONS OF NEW SPECIES³

Aphaereta soronastes, n. sp.

This is distinguishable from other *Aphaereta* by the short ovipositor; long, deep, crenulate notauli; anteromedian scutellar sulcus and rugose propodeum with large apophyses.

DESCRIPTION. Holotype: female, length 2.5 mm. Second flagellar joint 1.2 times as long as first; flagellum 21-jointed; cheek strongly flared out at outer margin of mandible socket.

Mesonotum polished; notauli deep, crenulate and extending 0.8 of distance to posterior margin; a small oval median fovea just in front of prescutellar fovea; the latter almost as large as scutellum; scutellum rectangular, about 1.5 times as wide as long and bearing a shallow median anterior sulcus. Mesopleural furrow broad and strongly rugose. Propodeum rugose, with large lateral apophyses and a strong median longitudinal carina; costulae vaguely indicated among the rugae.

Ovipositor sheath about half as long as hind tibia.

Color black, the following parts suffused with ferruginous: clypeus, mandibles, upper quarter of face, basal flagellar joints, prothorax, notauli, scutellum and adjacent areas, metanotum, tergite I, tergite II medially. The following parts yellowish: scape, pedicel, labium, maxilla, tegula and wing bases, all legs and coxae. Wings hyaline, veins and stigma brown.

Paratypes: females, flagellum with 21–24 joints, scutellum sometimes about as wide as long, clypeus often brown, tergite II sometimes black. Males: flagellum with 18–23 joints, notauli black, tergite II usually completely suffused with ferruginous, propodeal apophyses often inconspicuous.

TYPES. Holotype: ♀, Clemson, South Carolina, 11 August 1966, collected by Jerry A. Payne, reared from *Fannia* puparium found in pig carrion. Canad. Nat. Coll. No. 11201. Paratypes; 4♂♂, 6♀♀, same data but dates between 25 June and 27 October (CNC and U.S. Natl. Mus.).

Atractodes necrix n. sp.

This species is similar in size and general appearance to *A. americanus* Ashmead, which is also found about carrion in eastern North America. However, *A. necrix* flies in spring and summer, has hairy eyes and apical flagellar joints over 50% longer than wide. *A. americanus* flies in autumn, has glabrous eyes and apical flagellar joints about as long as wide.

³ The description of the following two species are written by the junior author.

DESCRIPTION. Holotype: female, length 6.5 mm. Flagellum 19-jointed, first joint 3 times as long as wide, subterminal joints about 1.6 times as long as wide and the same width as joint one. Eyes hairy. In dorsal aspect width of head : length of head = 1.75; width across eyes : width across temples = 1.07; width across eyes : width of frons = 2.0; length of eye : length of temple = 1.3. In facial aspect width of face : length of face (from apex of clypeus to lower margin of antennal sockets) = 1.25; eyes divergent below; clypeus shining and coarsely punctate, the punctures separated by about half their widths.

Mesonotum and mesopleuron shining and moderately sparsely but finely punctate. Combined petiolarea and areola transversely rugose peripherally, weakly granular centrally; greatest width of area (at junction of apical transverse carina) almost twice width at base or apex; length : greatest width = $2.0 \pm$.

Tergite I about $2\frac{1}{2}$ times as long as its apical width; the latter about equal to greatest width of petiolarea. Abdomen comparatively short and wide for the genus depth (at tergite II or III) about $1\frac{1}{2}$ times width; length (excluding tergite I) : length of tergite I = 3.0; length (excluding tergite I) : width at junction of tergites II and III = 4.5. Lateral crease on tergite II less than 0.1 times length of tergite. Tergites II and III with only a few short scattered hairs, but none near lateral margins; tergites IV-IX with a submarginal row of long sparse hairs; sternites II-VI with sparse scattered long hairs. Ovipositor sheaths together sub-hemispherical and densely set with hairs that are about as long as the sheaths; length of sheath : height = 1.0; height of sheath : height of cercus = 2.0.

Color black; the following parts reddish yellow: scape, pedicel, mouthparts, apical half of clypeus, upper hind corner of pronotum, tegula, wing base, all legs and coxae. Flagellum, veins and hind tarsi brown. Abdomen behind tergite I red, but heavily infuscated above behind tergite IV. Wing membranes weakly infumated.

Paratypes: females, flagellum with 18-19 joints, anterior end of combined areola and petiolarea sometimes narrowed to less than one-third greatest width of area.

TYPES. Holotype: ♀, Clemson, South Carolina, 28 July 1966, collected by Jerry A. Payne from pig carrion. Canad. Nat. Coll. No. 11202. Paratypes; 5♀ ♀, same locality and collector but dates 4-29 April and taken on various kinds of carrion, pig, dog and chicken (CNC and U.S. Natl. Mus.).

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